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ELECTRONIC MAGAZINE ON FOOD ANALYTICS, LEGISLATION AND QM IN PROCESSING

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December 2017

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Climate change conference in Bonn paves the way towards a better future for mankind

The 23. UN Climate Conference of the Parties (COP 23) took place in Bonn, DE 11-17 Nov 2017. More than 22'000 Government delegates and Non-Government Organsisations' (NGO's) observers from 193 countries discussed the implementation details of the Paris treaty of 2015 in order to prevent global warming from exceeding the 2 ° C or rather 1,5 limit.

eFOOD-lab International has gained an insight view into the various discussions: under normal circumstances Fiji would have hosted the COP 23 conferences. However, due to lack of conference facilities for so many people the COP 23 was organised by the German Government.

If you have ever observed the devastating effects of tropical hurricanes and rising sea levels on these smallest and most vulnerable island paradises it seems unethical to discuss the long-term future of fossil energies such as brown coal and to safeguard jobs. Very few individuals and countries do not accept the fact that climate change is ongoing and that mankind will suffer all around the globe if we do not reduce CO_2 emissions. But there is good news. Former California Governor Schwarzenegger stated during his speech:" it is not the US President who decides what US Federal States will do about climate change. Many of the States and communities will stay voluntarily on board of the Paris treaty in order to reduce emissions".

Since October 2017 China has closed 176'000 factories and 44'000 smaller coal plants. The country will invest 330'000 m € in renewable energies. In 2017 only, more solar power plants have been installed in China than in Germany ever since the technology has been developed. Still air pollution is the highest in world wide comparison. But China has identified and accepted the problem and implements effective measures.

In Latin America, Costa Rica is the leading nation in renewables: 98% of electric power is generated by green sources, thereof 69% from hydropower, 16% from on-shore wind power and 11% from geothermic power. Costa Rica is the first country in the region to start public transport with hydrogen fuel cell power technology, a technology that is commerciallly available in cars (Toyota Mirai) but lack of hydrogen gas stations limits their acceptance. But imagine, if the world is nearly free from emissions and "smog" in mega cities as a word would be eliminated from our vocabulary? It is possible.

We have invited the fuel cell technology expert Heinz Sturm from Bonn to explain how the food industry could use this innovative technology to reduce emissions and become more effecticve.

In March 2018 the AnugaFoodTec will open its doors for the entire food industry and its suppliers. The focus will be on ressource efficiency, an outcome of the intense discussion between eFOOD-Lab International and the Cologne Trade Fair.

EDITORIAL

One of the congress keynotes will be given by one of the world's leading scientists Prof Dr Michael Braungart, Hamburg/DE who is also co-founder of the McDonough/Braungart Design Chemistry in Charlottesville, US.

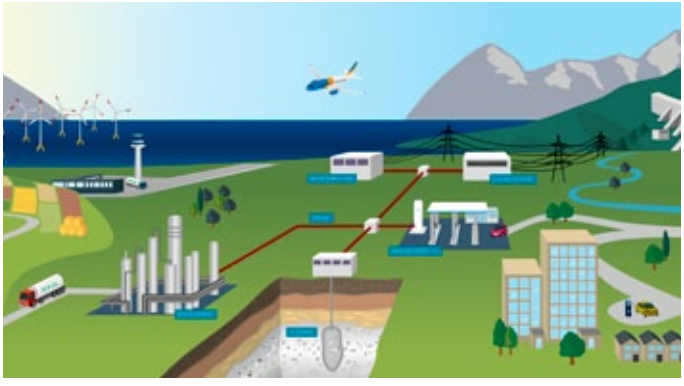
Braungart postulates a change in thinking: the target is not the reduction of waste or carbon foot print – the way forward is a new concept where only processes are applied resulting in product or technology cycles: the cradle-to cradle concept was born. We have asked Braungart to elaborate on his new approach in this issue.

Besides these new concepts we show again how food analytics prepare for the future. I wish you a nice read.

Sincerely

Thomas Kützemeier
Editor-in-Chief
www.mcongressconsult.de

CONTENT



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YEARS
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Hydrogen Economy for the food sector

Self-made bio energy from local resources to contribute to green footprint for the Food industry

Author: Heinz J. Sturm, Civil Engineer
Dipl. Hydrogen & Fuel Cell Technician Email: HeinzSturm@clean-energy-bonn.org

The production of the different products/food from animals contributes signifantly to the greenhouse effect. The CO_2, material, water and the required land area consumed for the production are closely examined and evaluated.

Climate-friendly products as well as production technologies including transport of goods in all areas of the Food industry are required. Hydrogen even as a feedstock for several food production systems is essential. The food industry needs the green footprint and suitable labels for the marketing of the products. For many years, organic labels have been a buying argument for the consumer. Carbon Footprint is one of these labels.

Technologies: hydrogen and fuel cells

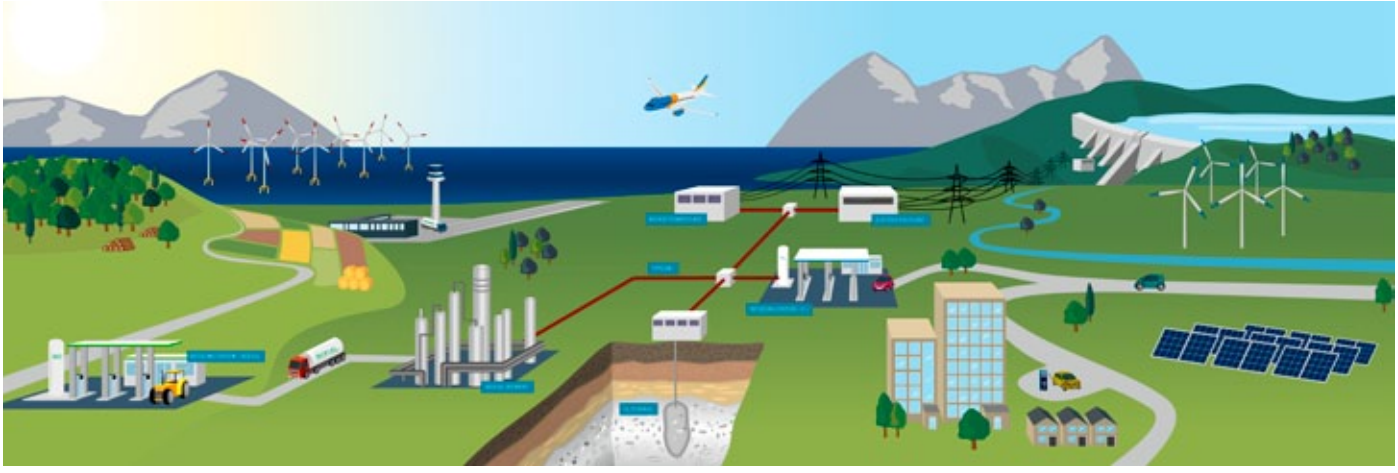
Fuel cells produce energy through an electrochemical reaction that uses hydrogen. This combustion-free technology is available today to power a range of applications.

With low-to-zero emissions, depending on fuel feedstock, and the additional benefits of high efficiency, reliability and scalability to any power need, fuel cells are now finding a niche powering various operations for food manufacturers.

What is a fuel cell?

Nothing else then a gasbattery. It combines hydrogen (from hydro) and oxigen from the air into water, heat and electricity.

Fuel cells have moved from outer space to everyday applications. Large fuel cells now act as power plants, located on-site to supply electricity, and in some cases, heating and cooling, to large buildings, office complexes and manufacturing facilities; smaller fuel cells power portable, off-grid and mobile applications, such as cars, trucks, tractors, boats, trains, planes, buses, rockets, drones, submarines, recreational vehicles and forklifts.



Renewable Hydrogen Production, -storage, -transport and -utilization for the Transport Sector, Household and Industry. (Source: Forschungszentrum Jülich GmbH)

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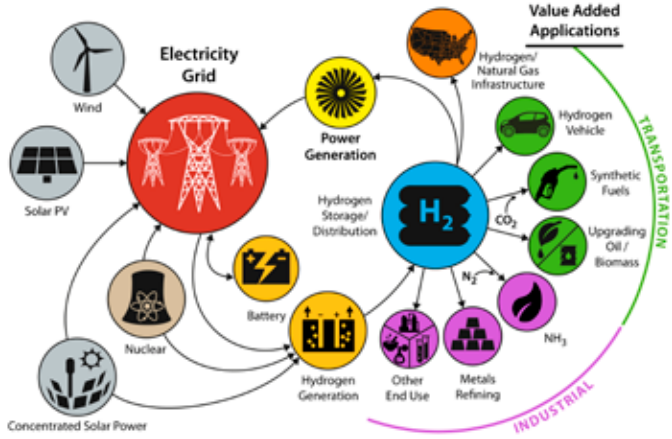


Power to Gas (P2G) and Power to X (P2X) for centralized and decentralized use and production of green hydrogen and synthetic fuels

Fuel cells use hydrogen, either directly or reformed within the system. When operating on pure hydrogen, in applications such as cars, forklifts and backup power, there are no greenhouse gas emissions. The only by-products are electricity, heat and water.

When using natural gas to power buildings and production facilities, the emissions are so low that several US states exempt fuel cells from air permitting requirements. The use of biogas can reduce lifecycle emissions to near zero.

Many food operations have adopted the use of fuel cell technology, with thousands of fuel cells now supplying power to processing facilities and bakeries, helping to move stock in warehouses and providing reliable energy to supermarkets.

They are doing so because of the many benefits of fuel cells: Exceptionally reliable and efficient. Capable of providing 100% power for as long as fuel is present, even in conditions down to -220F; virtually silent, reducing noise emissions. Scalable, so that by stacking individual fuel cells together, you can generate as little or as much power as needed.

Independent operation from the grid, allowing business operations to continue when grid power goes down, as an back up power. These attributes allow both stationary and mobile fuel cells to be operated indoors or out and permit stationary fuel cells to be sited on rooftops, in basements or adjacent to buildings.

Food processing

Keeping daily operations running efficiently and seamlessly in a processing, production or packaging/bottling facility requires a reliable source of power. Many companies for example in the US food industry are turning to fuel cells to provide electricity, and in some cases, heating and/or cooling to production sites.

The list is long and includes such household staples as Coca-Cola, Kellogg's, Pepperidge Farm, The Wonderful Company, and many more. These companies are finding savings on multiple levels, including reductions of emissions, energy costs and water use. Utilising waste as a source of fuel can further increase savings.

Distribution centres

Fuel cells are well-suited for low-temperature operation in refrigerated storage facilities and freezers, making the technology ideal for moving food products in supermarkets, food service distributors and food processor operations.

Today, more than 16,000 fuel cell-powered forklifts operate in US warehouses, including many in food logistics operations – Coca-Cola, Nestlé Waters, Newark Farmer's Market, Sysco, Walmart, Wegmans, Whole Foods Market, and many more. These companies are taking advantage of the strong business case for fuel cells, which includes cost, performance and productivity benefits.

The US Department of Energy (DOE) reports that, compared to battery forklifts, fuel cells have a lower total cost of ownership, an 80% lower refueling labour cost, and take up 75% less warehouse space compared to battery charging infrastructure[4].

The fuel cell cost advantage per unit is increased by $2,000/year per forklift for the average high-use facility[5]. Additional benefits include meeting or exceeding performance requirements in sub-zero warehouse temperatures, delivering constant power during the shift with no performance lags and refueling in minutes using a hydrogen dispenser.

Since there is no need to change a battery for recharging, operation down time is significantly reduced and valuable warehouse space used for battery storage can be returned to active use.

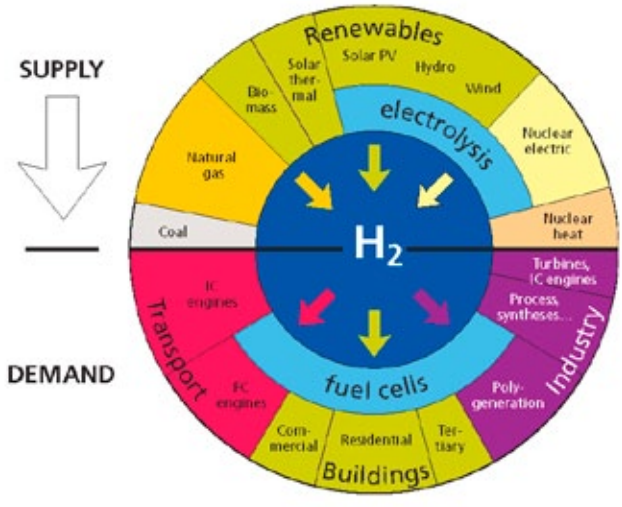
DOE/US reports that fuel cell-powered lift trucks operating on hydrogen made on-site from natural gas have about 33% fewer greenhouse gas emissions than lift trucks powered by batteries or liquefied petroleum gas (LPG).

The use of fuel cells goes well beyond forklifts. The US DOE is currently funding a demonstration project to determine the feasibility of fuel cell-powered refrigerated transport units (TRU) to replace diesel-powered internal combustion engines, currently used on trucks transporting refrigerated and frozen products. Fuel cells are well-suited for low-temperature operation in refrigerated storage facilities and freezers.

Grocers

Grocery stores are intensive energy users. After labour costs, energy costs are the most significant portion of the annual operating budget for the grocery retail sector. In a typical US store, refrigeration and lighting comprise about 80% of total electricity use and space heating accounts for 68% of natural gas use[6].

Most of this energy is delivered through traditional power generation, with a significant portion of the energy lost as heat. But this waste heat can be turned into useable energy through the use of CHP, where electricity is produced on-site and the exhaust heat is captured for the provision of heat, hot water and cooling. By providing more efficient energy use, CHP fuel cells have the potential to reduce electricity and natural gas costs for a facility. US grocery chains Whole Foods Market, Stop & Shop, Haggen, Safeway and Price Chopper operate fuel cell systems at several of their retail stores, generating 50-95% of the necessary power and heat onsite.



Supply Hydrogen from different sources and utilization/demand for Transport Sector, Buildings and the Food industry

The high reliability of fuel cells makes them an attractive power generation technology for businesses that customers rely on. By producing power on-site, fuel cells ensure continuity of power generation, allowing a grocery store to remain open to shoppers when grid power loss has closed down other businesses. This helps protect refrigerated and frozen foods from spoilage and waste and eliminates the need to send out a backup generator to power critical loads, store fresh items in a refrigerated truck, or to pack goods in dry ice to preserve them.

There are several real-world examples to point to. During superstorm Sandy (October 2012), fuel cell systems kept grocery stores in Colonie, New York and Middletown, Connecticut, up and running, supporting critical operations for 5-6 days when grid power was completely down. Another fuel cell provided a Torrington, Connecticut, based grocer with power, heat and cooling when grid power was intermittent due to the storm. In 2011, a San Diego, California, grocery store equipped with a fuel cell was one of the few businesses operating during a grid blackout.

Besides these impressive capabilities, fuel cells emit almost no pollutants, allowing them to be exempted from air permitting requirements. Other than an initial injection of water into the system, fuel cells also consume no water during operation, saving on water costs.

Other food businesses are using fuel cells to lower emissions. Global cold storage provider for the fish and agricultural industries, Americold, operates a 600-kW fuel cell system at its Salinas, California, warehouse to lower its electricity costs and cut greenhouse gas emissions. The fuel cell supplies 5.4 million kilowatt hours of clean and reliable power annually.

Conclusions

Fuel cells are proving themselves to have applications in various sectors of the food industry. The benefits are exceeding expectations, with several companies making installations at multiple sites and some utilising fuel cells to power facilities as well as forklifts at their distribution centres.

General solution

Power station of the future for electric supply of the Food production and Transport with hydrogen gas, fuel cells and batteries

The Bonn Climate Project combines renewable energy and sectoral coupling Projects also for the food sector. German solar and renewable energy off grid Technologies are based on low and zero Carbon gases; bio hydrogen gas and bio methane gas from local and natural resources in combination with gas Motors and gas fuel cells for universal use in households, for Transport/mobility and for industrial use include the Food sector as a feedstock. Renewable energies throughout the world are off grid using four elements: fire, water, air and earth.

Green electric power and green Hydrogen can be manufactured suitably and everywhere and can be used in combination for power, heat, all types of transport and mobility; residential use and industry (as a raw material or feestock) and even for drinking water production.

Decentralized, as well as in existing supply networks such as gas, and electricity and heat, by feeding green hydrogen and/or green electricity into the different grids. Also by additional heat which is produced as a by-product in fuel cells during electricity production, and which can be fed into a heating grid.

The use of valuable water which is produced instantly and is in addition in fuel cells by the chemical reaction of hydrogen and oxygen is a valuable asset in many dry regions of the world: green hydrogen and green electricity from the four elements.

The urban power station of the Futur: Coupling of all sectors to one System - poduction, transportation, storage and utilization; off grid and all over the world.

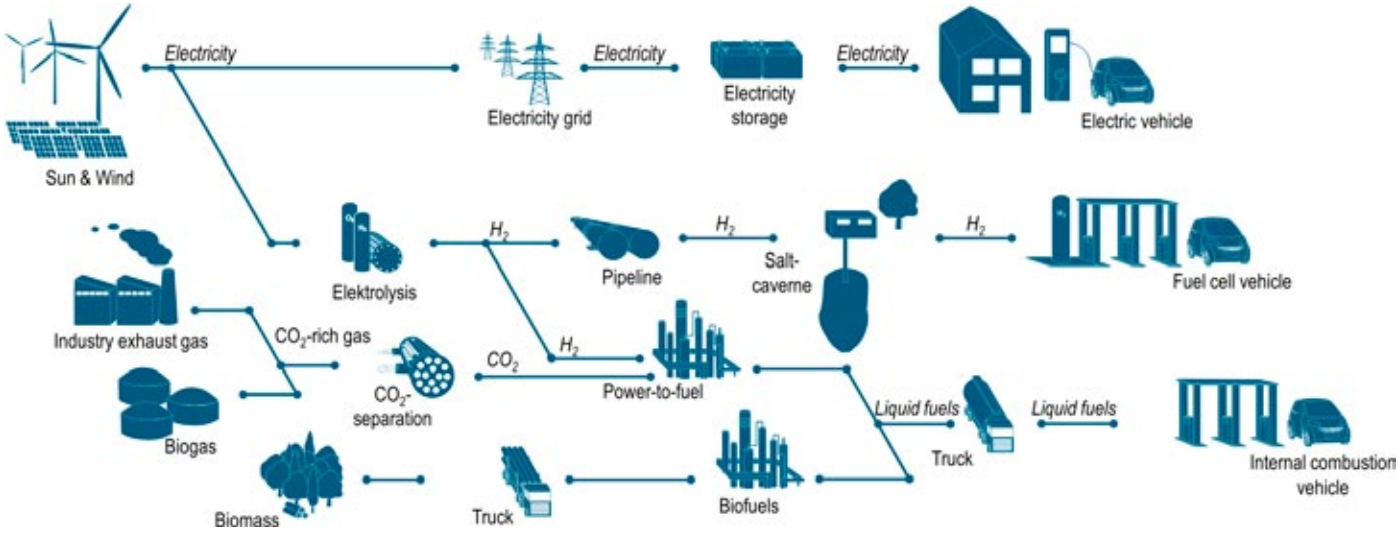
Climate protection and urban transportation

The future lies in hydrogen, fuels cells and batteries for electric mobility on the road, on rails, in the air, and on the water. Climate change comes more and more swift, stronger, and threatening. In order to meet the Paris climate treaty we need new urban transport solutions.

Electric engines in any vehicle are powered by electricity from batteries or fuel cells, produced by conversion of clean and environmental-friendly hydrogen (and oxygen from the air) in fuel cells, directly on board of a vehicle. After approximately 500km and more, the hydrogen tank is filled up at a hydrogen filling station, and the journey can be continued. These are considerable advantages over the charging time of battery-electric vehicles (cars, trucks, buses, trains, boats, ships, or aircraft)

Even batteries can be charged at home or at charging stations in the city within hours. Both electric transportion solutions have their markets and will help to avoid air pollution by CO_2.

In the years to come, we swiftly need to set-up the course for the introduction and market launch of different electric vehicles, and as the pre-requisite, the infrastructure in form of hydrogen filling stations for clean and affordable hydrogen gas, or electric charger stations, all over the world.



Power to Gas & Power to X for centralized and decentralized use and production of hydrogen and synthetic fuels (Forschungszentrum Jülich)

Hydra Boat and Waterbus powered by hydrogengas/fuel cells. A Project of ICEPS CTC BONN Technology Foundation

In the past few months, the first f-cell cars where presented to the international press in different countries, as well as a hydrogen f-cell railway train and likewise, aircrafts while on German roads, hydrogen f-cell cars and city buses are already evident. Now, we can also inform about the Hydra, the world's first hydrogen fuel cell-electric water bus, far ahead of its time, which also can immediately, be manufactured in series, and then promptly be an excellent contribution for active climate and water protection. Indeed, the boat, a passenger ferry, is a master piece of innnovation Made in Germany

Climate Action, how? What can be done? Comprehensive information needed!

How to escape the climate disaster and how to build a clean and affordable energy infrastructure? The solution is widespread, global deployment of clean energies and CO_2-free and low-carbon fuels, especially hydrogen and fuel cells.

Today the world is more active in climate protection than ever before. Air, water and soil, must be protected, any resource consumption should significantly be reduced, and waste of all kinds should be reutilisised. People need clean, affordable energy, worldwide, even in remote rural areas, and particularly, in the deserts and steppes of the Arabic/African countries.

The citizens of any country need to know about solutions, and our actions and decisions to copy and use.

Some principals

1. Water is life, energy and a fuel
2. Water is composed of hydrogen and oxigen
3. Water changes its state into hydrogen and oxygen and then back to water
4. Nothing is lost in the world. Everything only changed its status and can be used over and over again: from the solid to the liquid state to the gasous state. This is the hydrologic and hydrogen circle.
5. Our energy is utilised in the form of oil, gas, coal, or wood; all are hydro-carbon elements and compounds.
6. Take away the carbon and use only the hydrogen as a CO_2-free energy for universal use, as shown just it before

Urban water and waste management – Urban energy & transport – Urban planning and building – Clean air solutions; all belongs together and is active climate protection, a perfect overall project for sectoral coupling with hydrogen gas as a basic clean energy.

If the above-mentioned individual sectors work together, plan at an early stage and build on the basis of hydrogen and fuel cells, in the future, villages, cities, new living habits and ways of life can be created. The architectures of buildings will change significantly and construction will be simplified, many decentralized small fuel cells in buildings will enable simple electricity and heat production everywhere and decentral. Buildings will no longer depend on large central power plants for an entire building and wiring in the building.

New transport concepts based on electric vehicles of all kinds make life easier for us and are good for our health. Clean air and no noise and stress from car's internal combustion engines or diesel generators, which generate electricity in addition to many Building. Also no vibrations or noises are generated by the different uses of the hydrogen and the fuel cell in the transport sector as well as in the building sector.

Water and Waste Management.

The production of hydrogen via gasification technologies, by means of the steam reforming of all biomass waste, will completely solve the major problem of waste disposal. All types of biological household waste, (which contents the elements hydrogen, oxigen, nitrogen and carbon and different minerals,) industrial waste and other waste are completely gassed. In this case, the synthesis gas, hydrogengas, C02 and all minerals such as phosphorus, potassium, magnesium, nitrogen, calcium and metal parts in the garbage such as PB, Ferrum and others, are reused or deposited in the form of ashes. All other elements are valuable substances and come back into the life cycle, including valuable water from the biomass which is gasified.

Hydrogen supplies us with clean and affordable energy.

Fipronil in breakfast eggs?

Determination of pesticides in eggs, honey & co using UHPLC-MS/MS

Authors: Uwe Oppermann, Market Manager Food, Shimadzu Europa GmbH, Anja Grüning, CIPS, Shimadzu Europa GmbH, Telefon: 0203/7687-0, E-Mail: shimadzu@shimadzu.eu, Website: www.shimadzu.eu

The use of pesticides in the food chain is frequently in the public eye through media coverage of food scandals. In August, Fipronil (a broad spectrum insecticide) was found in eggs from the Netherlands and Germany. Millions of eggs were destroyed as a result. However, many were already on sale or being further processed. By now, eggs contaminated with Fipronil have spread far beyond the borders of Europe.

What is Fipronil?

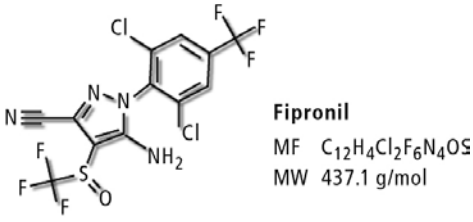


Figure 1: Fipronil structural formula

Fipronil is a broad-spectrum insecticide used in the control of pests such as ants, fleas, lice, ticks, cockroaches and mites. Use on food-producing animals (livestock) is not permitted. The World Health Organization (WHO) classifies Fipronil as a toxic substance which can damage the liver and kidneys after consumption of contaminated food. The Federal Institute for Risk Assessment (BfR) in Berlin, Germany, recorded analysis results from Fipronil polluted eggs in a concentration range of 0.0031 to 1.2 mg per kg, posing a health risk to children [1].

In order to protect consumers permanently from pesticide-contaminated food products as well as from non-intentionally added substances (NIAS) such as heavy metals or mineral oil hydrocarbons, regular food controls must be carried out. Only a fast and reliable analysis ensures early detection of exceeded maximum allowable concentrations, avoiding health risks to consumers and animals. Shimadzu has developed a high-sensitivity method to determine Fipronil and its metabolites in foods such as eggs and honey.

Fipronil in breakfast eggs: detected with UHPLC-MS/MS

Analysis was performed using a Nexera X2 UHPLC system coupled with LCMS-8060 triple quadrupole mass spectrometer as shown in Figure 2.

Figure 2: UHPLC-MS/MS system

Compound extraction was performed using a simple QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) method. 5 g of egg (egg white and eggyolk) were weighted into a 50 mL polypropylene tube, diluted with 5 mL of water and spiked with a respective amount of Fipronil, Fipronilsulfone and inaddition Fipronil-desulfinyl and Fipronil-sulfide (neochema, Germany).

10 mL of acetonitrile was added and the samples were mixed vigorously. After that ready to use QuEChERS extraction salts (Q-sepTM Q110, Pouch and tubes – cat. #26235, Restek) were added for sample drying and buffering. Samples were mixed again and centrifuged at 4500 rpm for 5 minutes. 1 mL of the supernatant was transferred into a dSPEtube (Q-sepTMQuEChERS dSPE – cat. #26217, Restek), shaken for 2 minutes, centrifuged, the supernatant was transferred into a glass vial and the pH was adjusted with 5 % formic acid solution in acetonitrile (10 µL/mL supernatant).

Dangers for bee colonies

Insecticides such as Fipronil and the neonicotinoids thiamethoxam, clothianidin and imidacloprid which are applied to protect crops, canola, soybeans, fruit and vegetables on agricultural land, affect the central nervous system of insects leading to paralysis and ultimately to death.

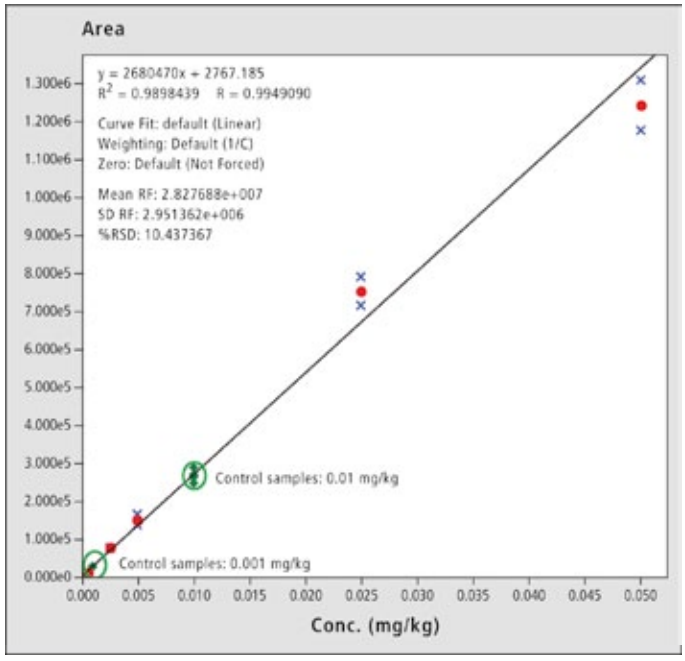


Figure 3: Calibration curve of Fipronil in egg ranging from 0.0005 mg/kg to 0.05 mg/kg

Use of these compounds has recently become controversial because they are believed to be a cause of Colony Collapse Disorder (CCD), a particular form of bee mortality in honey bees. Since honey bee pollination is essential for agriculture, extensive studies have been conducted to evaluate the impact of neonicotinoids on bee health.

In order to better understand the effect of these compounds on bees and the contamination of pollen and honey, a highly sensitive assay method was necessary. For this purpose, a UHPLC-MS/MS analysis has been developed, as was already done for the analysis of chicken eggs.

Sample preparation was performed using the QuEChERS method (Quick, Easy, Cheap, Effective, Rugged and Safe) with an additional dispersive Solid Phase Extraction step (dSPE) [3].

Honey sample analyses

Calibration curves were prepared in acetonitrile in order to obtain final concentrations ranging from 2.5 pg/ml (2.5 fg on the column) to 5 ng/ml. These concentrations correspond to 5 ppt or 10 ppb.

Nine honey samples purchased at the local supermarket or used as raw material in cosmetics (orange honey) were assayed as unknowns. All honeys tested showed neonicotinoid concentrations far below the maximum allowable residue limit. But even these low concentrations could be quantified thanks to the very high sensitivity reached.

A thyme honey sample with no detectable target compounds was spiked at 50 ng/kg with all substances prior to extraction. The resulting extract was then consecutively injected 150 times into thetedious sample preparation steps. The high sensitivity obtained enabled system. The results shown in Figure 4 show excellent signal stabilityassay in real samples at very low insecticide concentrations, far below the even at these low concentrations. This demonstrates that excellentregulated residue limit. The quantification limits are shown in Table 2. sensitivity can be maintained over a long series of real sample analysis thanks to the ion source ruggedness.

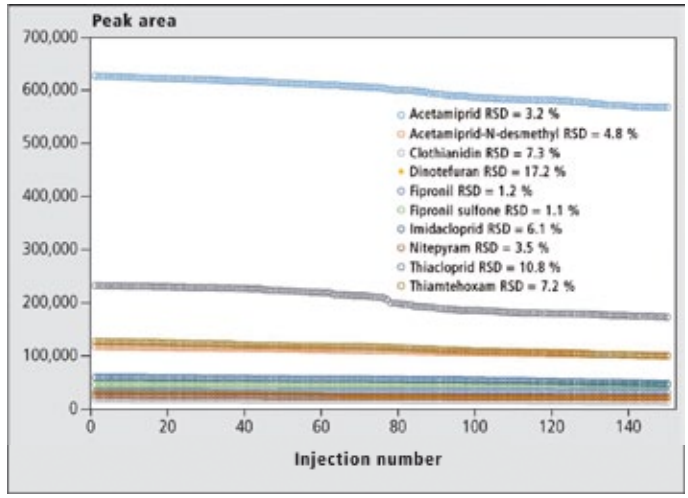


Figure 4: Stability of peak areas in real honey samples

Parameter Nexera X2 (Shimadzu)	Value
Analytical column	Raptor Biphenyl™ 100 x 2.1 mm, 2.7 µm (RESTEK)
Column oven temperature	35 °C
Injection volume	2 µL (using POISe*)
Mobile Phase A	2 mM ammonium formate + 0.002 % formic acid - Water
Mobile Phase B	2 mM ammonium formate + 0.002 % formic acid - Methanol
Parameter LCMS-8060 (Shimadzu)	**Value**
Interface voltage	- 3 kV
Q1 resolution	Unit (0.7 Da FWHM)
Q3 resolution	Unit (0.7 Da FWHM)
Nebulizing gas flow	3 L/min
Drying gas flow	10 L/min
Heating gas flow	10 L/min
DL temperature	150 °C
Heat block temperature	300 °C
Interface Temperature	350 °C

Table 1: System parameters UHPLC-MS/MS

Compound	LOQ (µg/kg)	Compound	LOQ (µg/kg)
Acetamiprid	0.005	Fipronil sulfone	0.001
Acetamiprid-N-desmethyl	0.005	Imidaclorpid	0.020
Chlothianidin	0.020	Nitenpyram	0.020
Dinotefuran	0.010	Thiacloprid	0.005
Fipronil	0.001	Thiamethoxam	0.005

Table 2: Quantification limits in honey

Summary

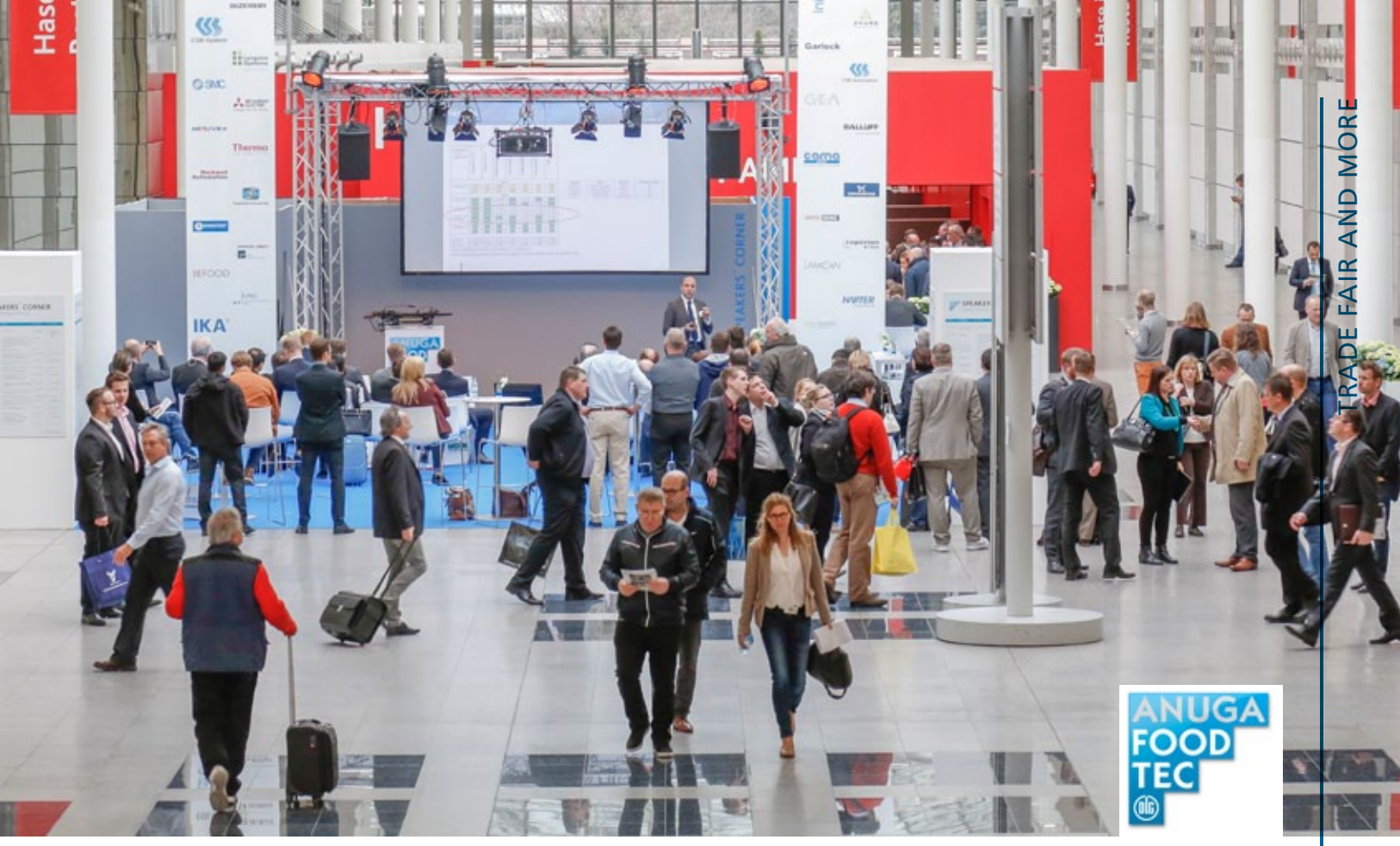
A method has been developed for the most sensitive analyses of Fipronil and neonicotinoids, which can be used for different foods such as eggs and honey. Sample preparation was simple and provided excellent recovery rates. The injection mode used (POISe mode) avoided the need for

References:

[1] Gesundheitliche Bewertung der in Belgien nachgewiesenen Einzeldaten von Fipronilgehalten in Lebensmitteln tierischen Ursprungs, statement no. 016/2017 of the BfR of July 30th, 2017

[2] Application news SCA_210_038, Sensitive method for the determination of Fipronil in egg using UHPLC-MS/MS [LCMS-8060]

[3] Shimadzu News 2017/1, Pesticides: killers of bee colonies, P. 2-5



Speaker' s Corner, Passage 4/5 (photo: Koelnmesse)

Trade fair and more

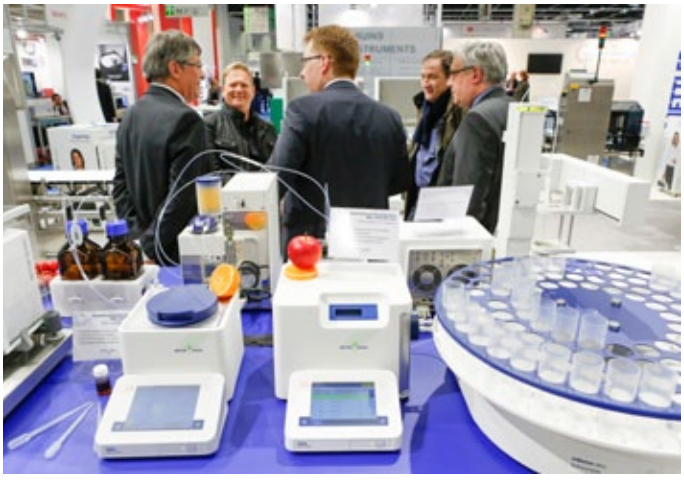
The event and congress programme of Anuga FoodTec 2018

Anuga FoodTec is the leading international supplier fair for the food and beverage industry. It will be proving this once again from 20 to 23 March 2018: Around 1,700 suppliers from more than 50 countries will be presenting their new products for the production and packing of all types of food on 140,000 square metres of exhibition space. The comprehensive range of exhibits will once again this year also be accompanied by a multi-faceted event and congress programme. Target group-specific lectures, conferences, forums, guided tours, special events and networking events will thereby create additional impulses and added value for the exhibitors and visitors. The top theme of Anuga FoodTec 2018 is Resource Efficiency. As usual, the German Agricultural Association (DLG) is responsible for the professional organisation of the congress programme.

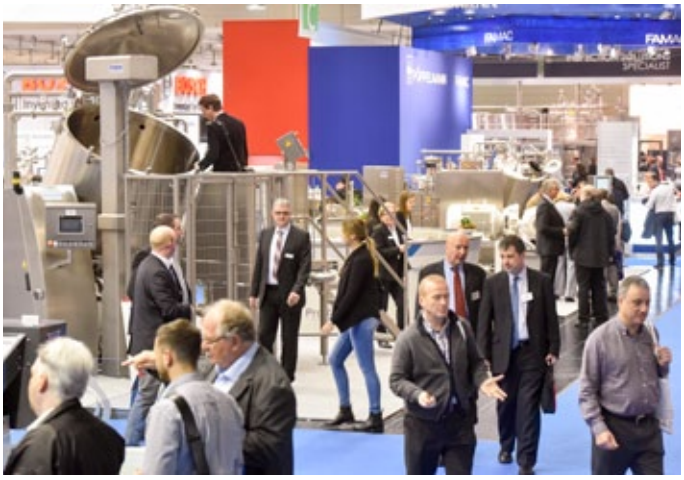
Optimise production processes, reduce the energy and water consumption, minimise the loss of foodstuffs as far as possible: The half-day opening conference of Anuga FoodTec, which is completely dedicated to the theme resource efficiency, demonstrates this and much more. The speakers are the internationally renowned experts Prof. Dr. Michael Braungart (Scientific Manager of the Hamburg Environmental Institute (HUI), Hamburg,), Prof. Dr. ir. Ruud Huirne (Food & Agri Director, the Netherlands, Rabobank), Prof. Pierre Pienaar (President of the World Packaging Organisation) and Prof. Dr. Alexander Sauer (Director, Institute for Energy Efficiency in Production EEP, University of Stuttgart). The opening conference is scheduled to take place at 2:00 p.m. on 20 March, in the Europasaal of the Congress Centre East.

Diversity guaranteed: The expert forums of Anuga FoodTec

From food and beverage technology, to packing, through to current and future trends: The expert forums of Anuga FoodTec offer numerous possibilities of informing oneself and



Stand: Mettler Toledo, Food Safety and Quality Management, Hall 5.2 (photo: Koelnmesse)



Impression, Hall 7 (photo: Koelnmesse)

for the exchange with national and international experts. This year's leading theme 'Resource Efficiency' is both the focus of the forum and the opening conference. Two further focuses of the export forums are 'Themes, Trends, Technologies – that are moving the food industry' as well as 'Food Ingredients'. An overview of the expert forums can be found under the following link: http://www.anugafoodtec.com/aft/trade-fair/events/Meeting-Points_Forums/index.php

Guided Tours: guided and well-informed

The guided tours offer a compact and informative overview of specific themes of the food and beverage industry. In the course of the tours, selected exhibitors will present and explain their products, machines and functions live on-site. Interested visitors can take part in different tours daily. The themes of the guided tours include among others robotics, Industry 4.0, more flexibility in the filling and packing technology, meat and dairy technologies as well as innovative packing materials. Registrations are possible from 24 January onwards and are urgently recommended. This link will take you to the guided tours http://www.anugafoodtec.com/aft/trade-fair/events/eventsearch/index.php

Anuga FoodTec 2018: Plenty on the programme

Anuga FoodTec 2018 exhibitors will present their companies, their product range and/or innovations to a broad trade audience in the Speakers Corner. A different, exciting theme is on the agenda every 30 minutes throughout the entire duration of the trade fair. The Speakers Corner can be found in Passage 4/5. Furthermore, the trade visitors can look forward to special events like the 'Robotik-Pack-Line' or a special exhibition on the theme of 'Packaging Design'. The numerous live presentations of the exhibitors round off the Anuga FoodTec experience perfectly. Those, who would like the opportunity to see a certain machine in operation can inform themselves online about the demonstration times of the machines shortly before the fair begins. Interested parties can find the respective categories and the demonstration times of the machines via the event search and the option "Extended Search"/"Themes".

All information and regular updates on the event and congress programme are available on the homepage of Anuga FoodTec at http://www.anugafoodtec.com/aft/trade-fair/events/index.php

Koelnmesse – Global Competence in Food and FoodTec

Koelnmesse is an international leader in organising food fairs and events regarding food and beverage processing. Trade fairs such as the Anuga, ISM and Anuga FoodTec are established world leaders. Koelnmesse not only organises food trade fairs in Cologne, Germany, but also in further growth markets around the globe, for example, in Brazil, China, Colombia, India, Italy, Japan, Thailand, the United States and the United Arab Emirates, which have different focuses and contents. These global activities enable us to offer our customers a network of events, which in turn grant access to different markets and thus create a basis for sustainable and stable international business.

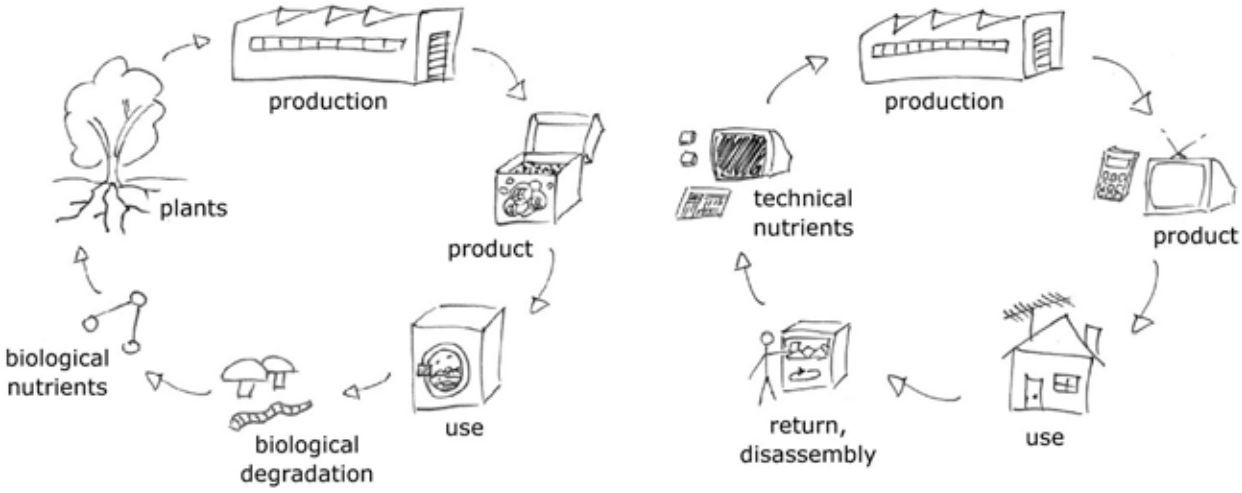
Further Information is available at:
www.global-competence.net/food

Stand: ecolean, Packaging, Hall 7 (photo: Koelnmesse)

Cradle-to-Cradle

Effectiveness as a new approach for analysis and test-equipment

Author: Prof. Dr Michael Braungart, Braungart@Braungart.com

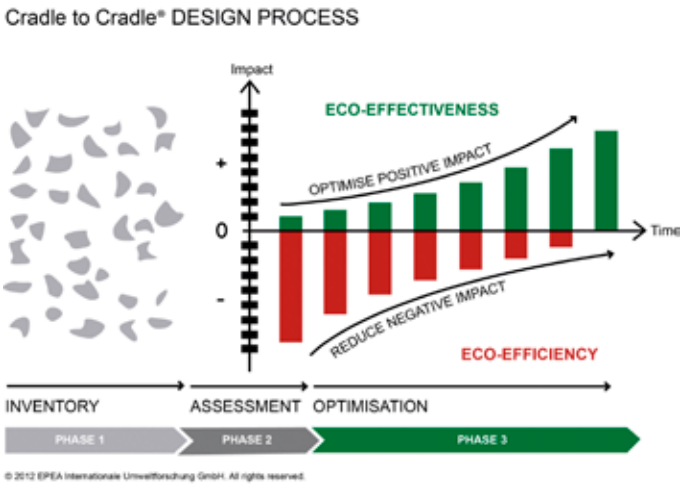


The Cradle to Cradle® metabolisms are divided into biological (left) and technical cycles. Biological nutrients constitute products of use, such as textiles and car tires. Technical nutrients constitute products made of rare raw materials that can and should be kept out of the environment. Technical nutrients include products such as washing machines, or bicycles (graphic: EPEA GmbH).

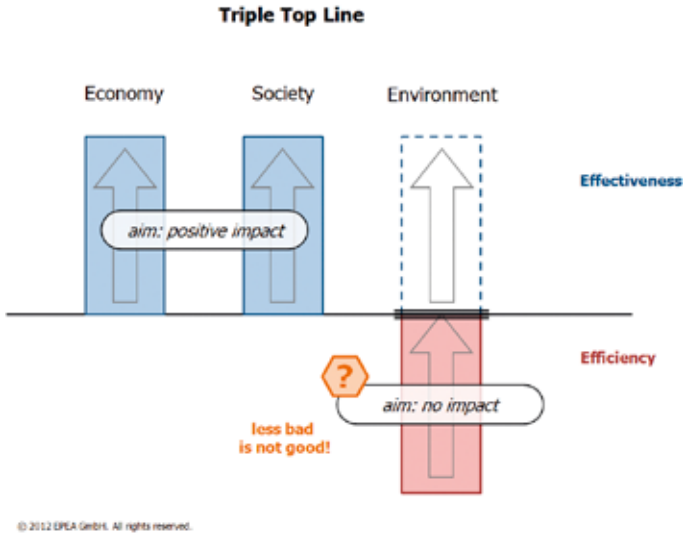
Traditionally, people think it is environmental protection when they destroy less: "Please, protect the environment, reduce your water-consumption." "Reduce your energy-bill." "Reduce your waste-production." "Protect the environment." You can see this in every hotel, where protection means to use fewer towels, to use less detergent, etc. But this does not really protect the environment – it only destroys less. Do you really protect your child when you only beat it three times instead of five times?

In this sense, East-Germany and Poland had been protecting the environment much better than West-Germany or the Netherlands before re-unification. In 1991, the EPEA-institute started a systematic analysis of environmental quality and diversity in East-Germany. It became clear that the quality of soil and the species diversity was so much higher than in most parts of West-Germany. The main reason for this was not legislation – it was just inefficiency. The system was so inefficient that it left a lot of highly contaminated spots. But overall, the environmental quality was so much higher than in West-Germany, just due to inefficiency. So if you do something wrong, don't make it perfect – otherwise, it gets perfectly wrong.

Because West-Germany promised to provide the same quality of life in both parts of the country, sludge from paper-recycling



Phase 1: collecting an inventory of all the materials in a product. Phase 2: Assess all the materials to determine their environmental and human impact. Phase 3: Instead of just minimizing the amount of undesirable materials, and processes in a product (ecoefficiency) work towards implementing changes that allow for the use of positive materials, and processes (ecoeffectiveness).



Cradle to Cradle® design creates triple top line growth. Products are designed to be equally beneficial to the environment, society and the economy.

was brought to East-Germany for more than 10 years in order to improve the soil quality, millions and millions of tons. This paper was never intended to be recycled: the sludge contained contaminations which are not suitable to go into biological systems. This practice ended: today, the paper-recycling sludge goes into cardboards and contaminates food, as has recently been shown for pizza-packaging from different producers. However, this contamination is not just limited on pizza: all these paper-boards have such a contamination-problem. This is why we would like to look more profoundly at the design of products and packaging.

Isn't it interesting that people want to be good for the economy, good for society – but when it comes to the environment, the highest level is not to exist, to be carbon-neutral, to be climate-neutral. You can only be carbon-neutral or climate-neutral if you don't exist. Did you ever see a climate-neutral tree? Or a carbon-neutral tree? We need to learn to generate a beneficial footprint instead of minimizing our footprint. It certainly makes sense to minimize the use of fossil fuels. But where is our beneficial footprint?

For being less bad, we are too many people on this planet. This is why we need innovation where we can show what products can look like. But right now, they are amazingly primitive. For example look at the heavy-metal content of toner dust from a laser-printer, where there is no quality-control, neither about the composition nor the size of the particles. A diagram by the Hamburg Environmental Institute (HUI) clearly shows this. Or let's take a silicon-material, which is used for ice-cubes or baking dishes. Silicones aren't even regulated by REACH. In Cradle-to-Cradle, there are only two different cycles: the technosphere and the biosphere. It eliminates the concept of waste based on renewable resources and energy-sources and celebrates diversity.

From efficiency to effectiveness

The shift from efficiency to effectiveness necessitates a fundamental redesign of products and the system of industrial material flows within which they circulate. Cradle-to-Cradle design defines a broad framework for creating eco-effective industrial systems, but for businesses to put this framework into practice they need both the right technologies and the right strategies.

Standard life cycle assessment (LCA) is an unsuitable approach for generating eco-effective products and processes because its linear nature does not allow for optimization in the context of Cradle-to-Cradle design. Braungart and McDonough[1] have defined a stepwise strategy for businesses to realize the transition from eco-efficiency to eco-effectiveness on the level of product design:

Step 1: Free of ...
Step 2: Personal preferences
Step 3: The passive positive list
Step 4: The active positive list
Step 5: Reinvention

This five-step process begins with an elimination of undesirable substances and moves towards the positive definition of desirable substances (Step 4). Ultimately, Step 5 calls for a reinvention of products by reconsidering how they may optimally fulfill the need or needs for which they are actually intended while simultaneously being supportive of ecological and social systems.

Step 1: Free of ...

Most companies today have a very limited knowledge of the toxicological and eco-toxicological characteristics of the substances that make up their products. An automobile, for instance, may contain thousands of different materials and chemicals. Gaining an understanding of the impact that each of these materials may have on the natural environment and human health is an immense undertaking, and something that the large majority of businesses have not done and do not immediately have the capacity to do.

Step 2: Personal preferences

Once the most undesirable substances have been removed from a product, the next step is to begin to make educated choices about

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those substances that should be included in the product. Though the best way to do this is to have a detailed knowledge about the impacts of a particular substance on ecological and human systems throughout its life cycle, this is often impractical or even impossible. Furthermore, different substances have different types of impacts. Should a company prefer a substance which is potentially sensitizing or one which is persistent in the environment; a substance that may contribute to global warming or one that might end up harming marine life?

Step 3: The passive positive list

Step 3 includes a systematic assessment of each ingredient in a product to classify them according to their toxicological and eco-toxicological characteristics, especially their capability to flow within biological and technical metabolisms. For products of consumption, criteria to examine shouldinclude for instance: toxicity to humans (acute, delayed, developmental, reproductive), aquatic toxicity, persistence and bioaccumulation in nature, sensitization potential, mutagenicity, carcinogenicity and endocrine disruption potential. Based upon the assessment of a material or chemical according to these criteria, a passive positive list can be generated which classifies each substance according to its suitability for the biological metabolism. This list can be used to determine the degree of additional optimization necessary for a particular product to be a true product of consumption.

Step 4: The active positive list

Step 4 includes the optimization of the passive positive list to the point until each ingredient in the product is positively defined as a biological or technical nutrient. Whereas step 3 establishes knowledge of the degree to which each component in a product needs to be optimized, step 4 implements this optimization to the fullest degree.

Climatex® Lifecycle™ upholstery fabric is an example of a product whose constituent materials are positively defined as biological nutrients. Created in a collaboration amongst EPEA Internationale Umweltforschung GmbH, McDonough Braungart Design Chemistry and Rohner Textil, Climatex® Lifecycle™ is a completely biodegradable and compostable fabric. Each component was selected according to EPEA's positive listing methodology for its positive environmental and human health characteristics and its suitability as a biological nutrient.

The fabric is made from natural fibers, including wool from free-ranging, humanely sheared New Zealand sheep, and Ramie, a tall, fibrous plant grown in Asia. To identify suitable dyes for the fabric, 60 major dye producers were asked to provide the necessary information on their best dyes to enable an assessment of their suitability as biological nutrients. From a selection of 1600 dye formulations, EPEA utilized their methodology to identify 16 that met both the desired technical and environmental specifications[2].

The optimization of the materials and dyes used in the product also has an impact upon the environmental profile of the production process. Before eco-effective optimization of the product, trimmings from the mill were classified as hazardous waste requiring special (and expensive) disposal. After optimization, waste material from the mill could be made into felt to be used as garden mulch, and in the cultivation of strawberries, cucumbers and a wide range of other plants.

Step 4 also applies for products of service. An automobile, for instance, might be designed so all of the materials and components it contains are biological or technical nutrients. Brake pads, tires and interior upholstery might be designed as biological nutrients because these are components that will likely degrade over the period of use of the car. The frame and body, on the other hand, might optimally be designed as technical nutrients like steel and polypropylene so they can be regained and upcycled into new automobile components or other products after the use period of the car.

Step 5: Reinvention

Where step 4 stops at the level of redefining the substances in a product, step 5 involves a reinvention of the relationship of the

Component	Analytical result	Dimension	CAS-Nr.
Trimethysilanol	20000	ng/h	1066-40-6
Hexamethylcyclotrisiloxan	12000	ng/h	541-05-9
Hexanal	7400	ng/h	66-25-1
Oktamethylcyclotetrasiloxan	36000	ng/h	556-67-2
Cyclohexanon	13000	ng/h	108-94-1
2-Ethyl-1-hexanol	110000	ng/h	104-76-7
Limonen	35000	ng/h	138-86-3
Dekamethylcyclopentasiloxan	44000	ng/h	541-02-6
Nonanal	68000	ng/h	124-19-6
Dodekan	29000	ng/h	112-40-3
Ethylanilin	28000	ng/h	103-69-5
Dodekamethylcyclohexasiloxan	150000	ng/h	540-97-6
Tridekan	38000	ng/h	629-50-6
Benzothiazol	28000	ng/h	95-16-9
Tetradekan	56000	ng/h	629-59-4
Tetradekamethylcycloheptasiloxan	270000	ng/h	107-50-6
Pentadekan	46000	ng/h	629-62-9

The results of an off gassing test of a typical silicone based ice cube tray.

product with the customer. The concept of reinvention addresses the interconnected nature of ecological, social and economic systems by pushing the idea of the biological and technical metabolisms beyond the confines of existing product and service forms. Strategies for reinvention view products from the perspective of the services they provide and the needs they fulfill for customers and for the broader context of social and ecological systems.

The product of service concept offers an ideal strategy for this. One might think about a washing machine, for instance, in terms of the service it provides: a convenient cleansing system for clothes. When customers purchase a washing machine, they are not paying for ownership of the materials it contains but for this service that it provides. If companies began to sell the service of a convenient cleansing system for clothes instead of the material object of the washing machine, a new set of immediate benefits becomes apparent. A company could potentially still provide a washing machine to customers, but perhaps under the form of a time-limited lease, or 3000 cycles of washing including service and possibly even detergent and water. Ownership of the washing machine itself would not change hands.

One benefit of such a system is that customers are no longer confronted with the liability associated with owning a product which contains potentially hazardous materials, connected with the dilemma of what to do with them at the end of the product's useful life. Another benefit for customers is that their interests are now aligned with those of their service provider. Under a traditional situation of ownership transfer, it is at least partially in the interest of the company to provide a product that fails as quickly as possible because this enables them an opportunity to sell yet another washing machine to their customer. This system encourages the production of cheap, low-quality goods. When products are provided in the form of a service scheme, however, companies are interested in producing the best product possible, because the better the needs of customers are fulfilled the more likely they are to remain customers after the end of the service period. Furthermore, when products are constructed using biological and technical nutrient materials, companies have the added benefit of getting these valuable nutrients back after the product's defined use period. This enables the application, for instance, of high quality technical nutrient materials like polysulfonic polymers, which are too expensive for application in most products when they are not regained after use. The result is higher quality and less expensive products.

Conclusions

Eco-effectiveness is a concept for the production and consumption of goods and services that goes beyond the reduction of negative consequences implied in eco-efficiency and zero emission. Eco-effectiveness positively defines the beneficial environmental, social, and economic traits of goods and services, thereby eliminating the fundamental problems (material flow quality limitations, antagonism to economic growth and innovation, and toxicity) that arise in eco-efficiency strategies.

Eco-effectiveness encompasses a set of strategies – Cradle-to-Cradle design, positive lists, intelligent materials pooling, etc. – that enable the formation of cyclical material flow metabolisms. Eco-effective material flow systems not only empower materials to maintain their status as resources, but by establishing a coherent network of information flows amongst actors in the material flow chain, they enable a continual accumulation of knowledge that forms the basis for true upcycling. This continuously accumulating intelligence becomes a perpetually source of added value to products and services, and provides for a supportive relationship between eco-effective industrial systems and long-term economic prosperity. The aim is not only to achieve zero emissions, but to utilize materials in a way that maintains or increases their value and productivity over time.

A typical silicone base ice cube tray made with undefined materials.

Coherent biological and technical metabolisms ensure the availability of raw materials for industrial processes. In the technical metabolism, material reprocessing is conducted by industry and generates added employment and further economic activity. Within the biological metabolism, material reprocessing is carried out by ecological processes, and results in the regeneration and replenishment of natural systems. This supportive relationship between the biological metabolism and the health of natural systems is the basis for a positive recoupling of the relationship between ecology and economy.

Cradle-to-Cradle offers solutions for the food industry and specifically for laboratories to use technical equipment as services and to do analysis around leaching, off-gassing of products far beyond the existing levels.

References:

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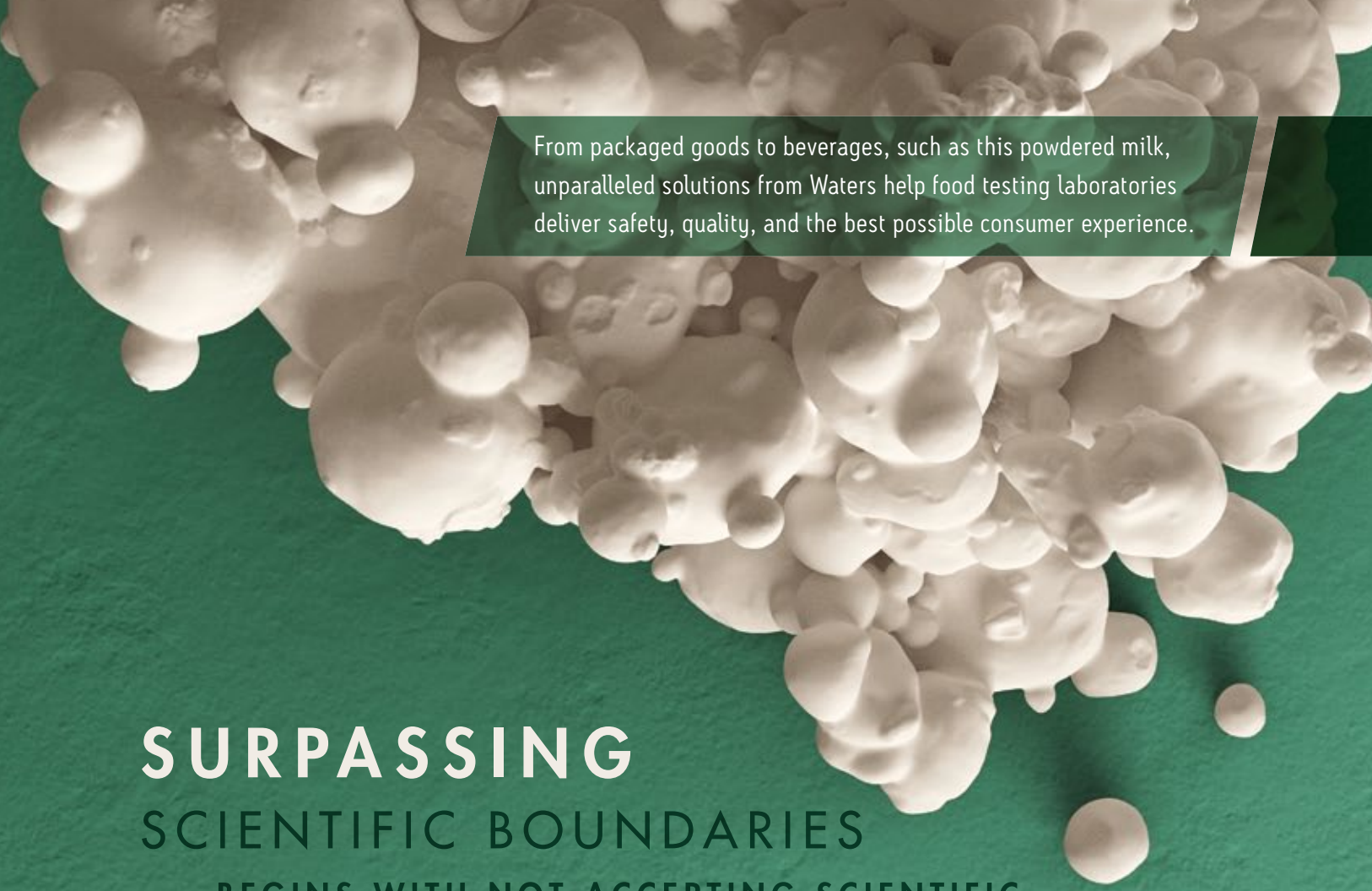

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